

High-Speed 34-m Beam Waveguide Antennas Potential Uses (Orbital Debris)

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JPL Sec. 333

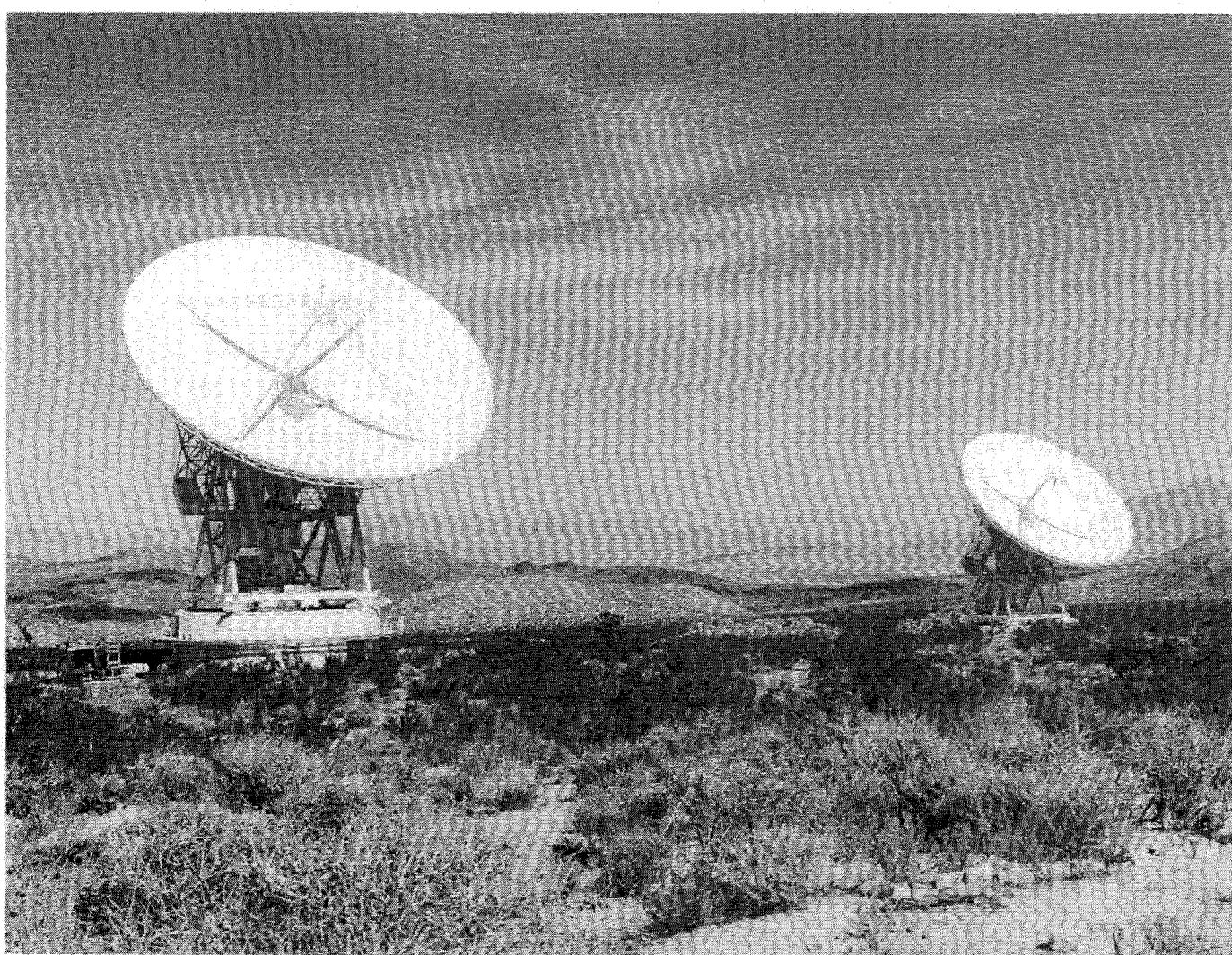
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Background

- In the early 1990's the US Army funded JPL to build appropriate hardware and conduct tests regarding coherent uplinking to spacecraft in LEO
- Two 34-m diameter beam waveguide antennas were built
 - Antenna Tracking:
 - Azimuth rate 3 deg/s accel: 1 deg/s
 - Elevation rate 2 deg/s accel: 0.5 deg/s
 - Monopulse angle error: 2 mdeg per axis (7.2 GHz)
 - Transmitter: 5kW peak, 100 μ s pulse, 50 pps
 - Receiver: un-cooled HEMT; System Noise Temp: 182 K
- Achieved phasing accuracy < 4° rms at 23 dB SNR
- Verified that coherent uplinking to LEO s/c is feasible
- Transferred antennas to the Deep Space Network (DSN) (renamed DSS-27 and DSS-28) for long-term use and maintenance

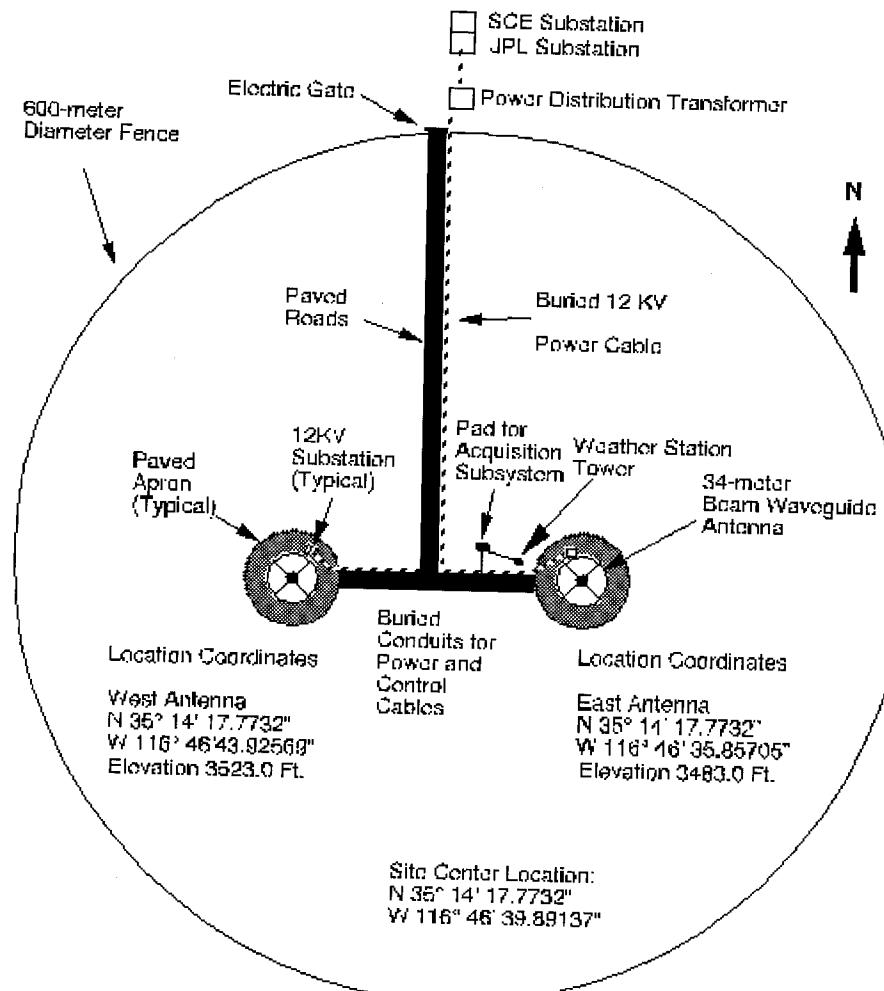


PROPRIETARY DATA - JPL/AEROSPACE MOU

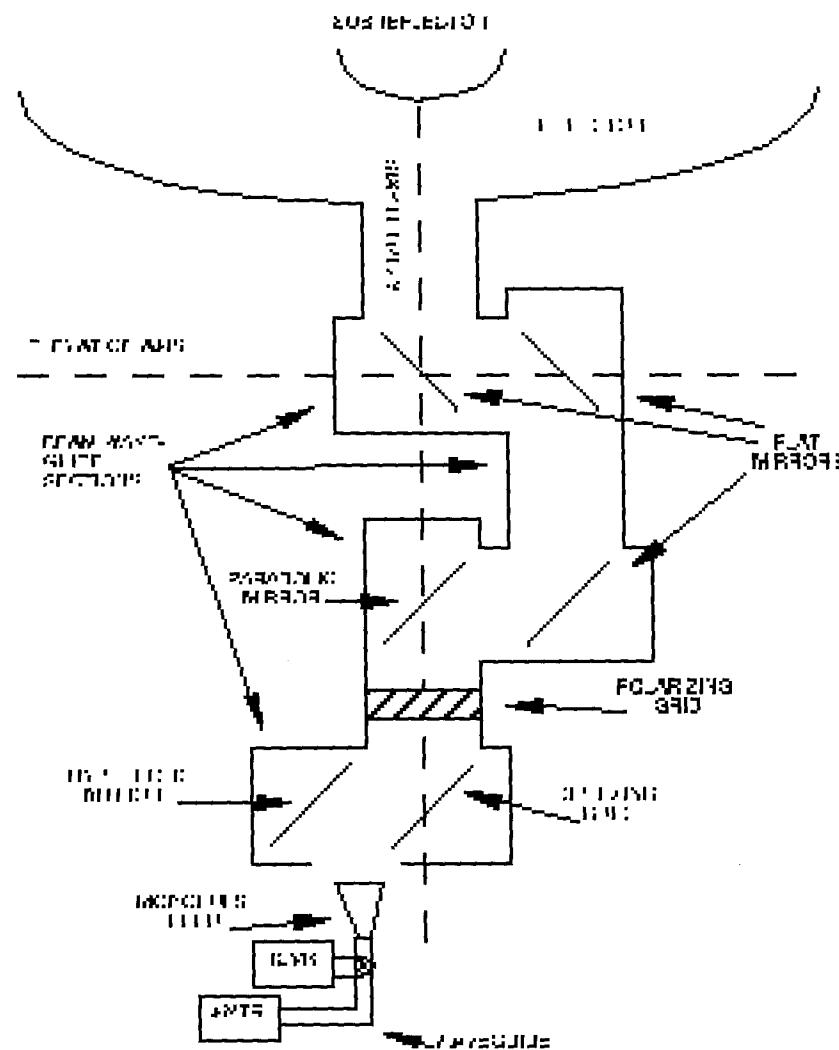


13 July, 2001

Antenna Site



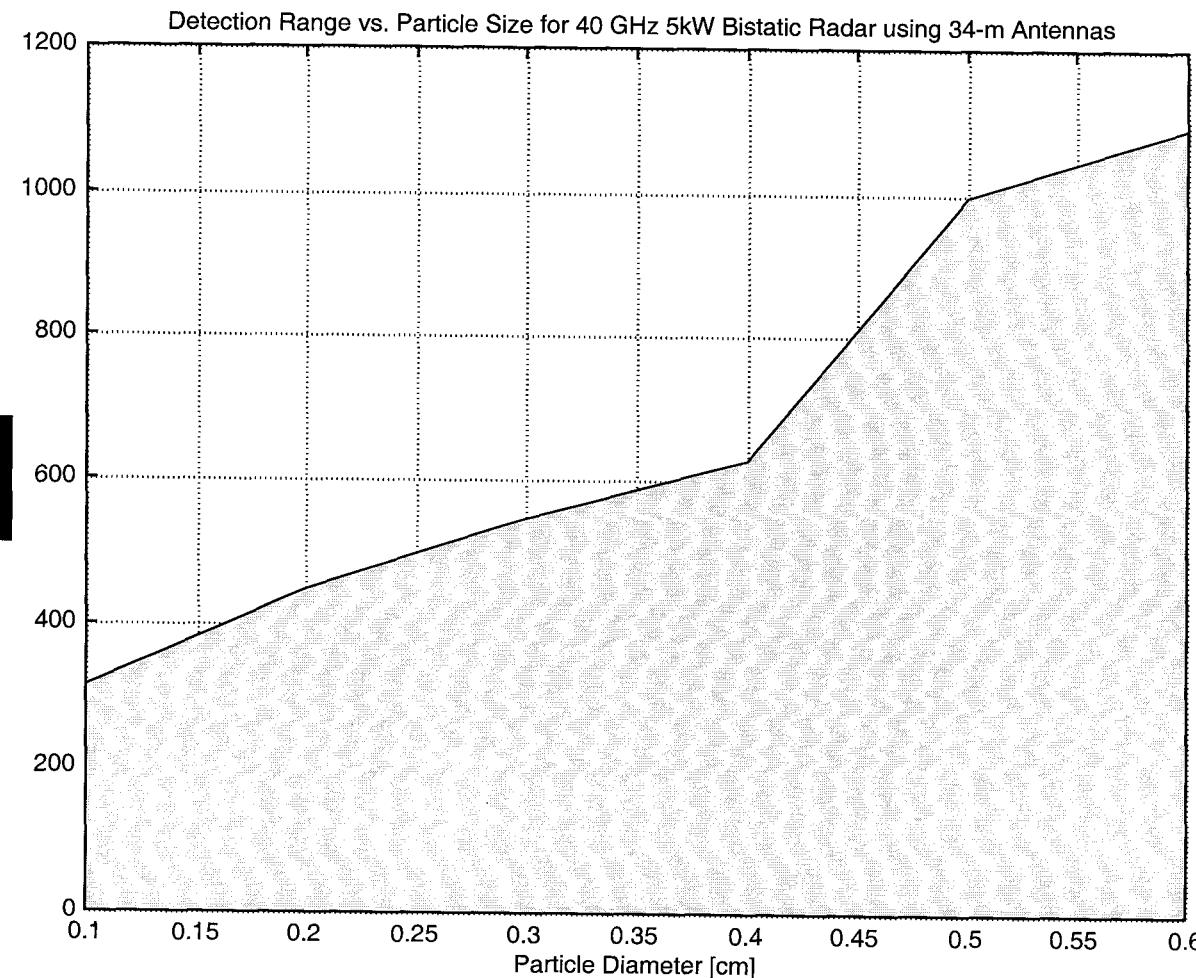
Beam Waveguide Antenna Optics



Search for Follow-On Applications

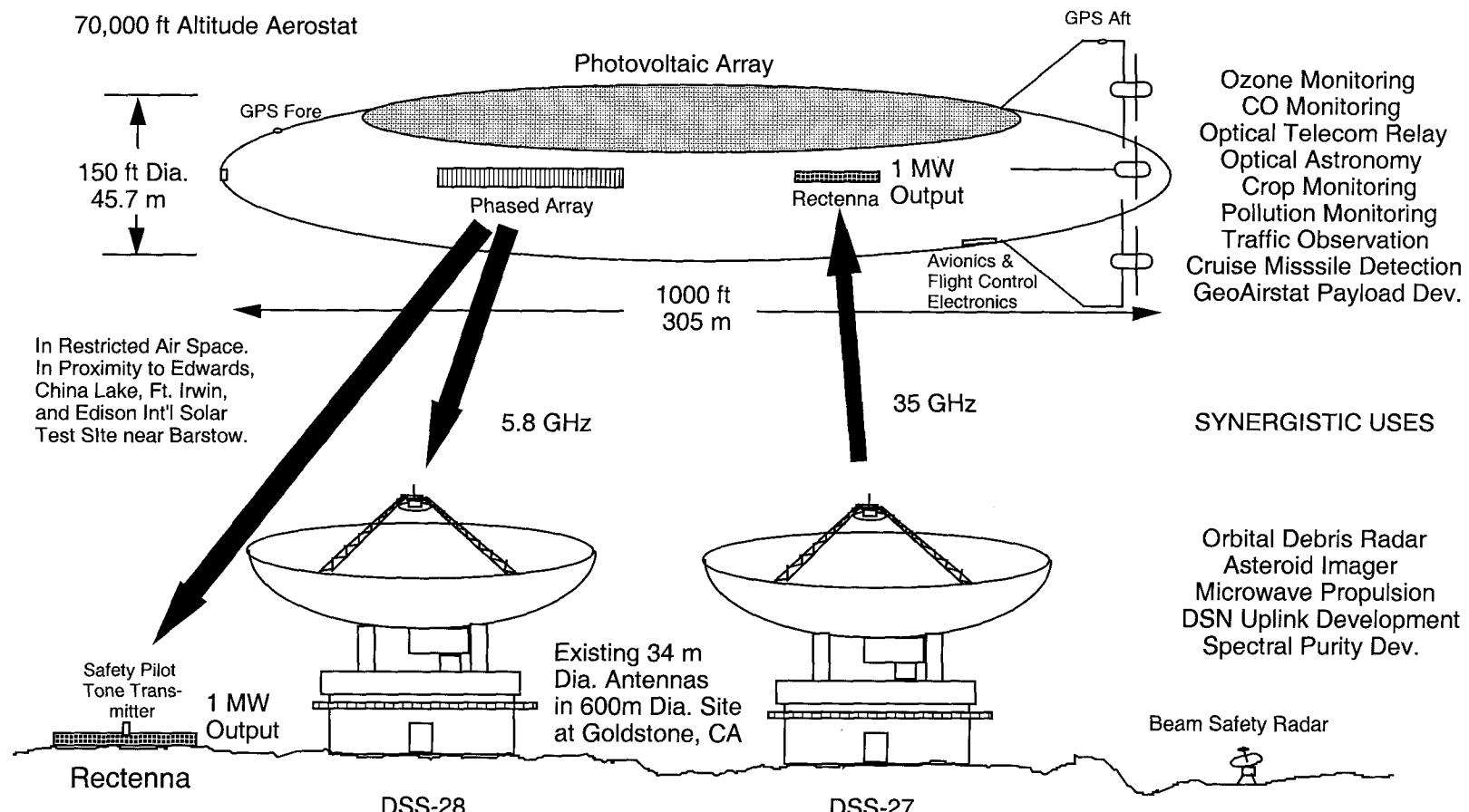
- DSN - Limited use because:
 - Optics design limits system noise temperature
 - Antenna structure built for “10-year operation”
 - Current plans:
 - “DSS-27 - used for tracking of a limited set of LEOP (Launch and Early Orbit Support) and HEO (Highly Elliptical Orbit) missions. Future DSMS plans consider upgrading the transmitter to make it usable for additional LEOP/HEO missions.
 - “DSS-28 - not used, but some discussions are on-going regarding using it as an extension for GAVRT”
- Orbital Debris
 - Concern about debris near International Space Station’s orbit
 - Proposed facility to JSC as a means to study
 - Models of debris interaction with the atmosphere
 - Tracking requirements for a larger (phased array) system

Predicted Performance at 40 GHz



Wireless Power Concept

Proposed Space Solar Power Gemini Wireless Power Transmission Facility



PicoSat/MEPSI Support

- Met with Ernie Robinson, et al on 7/6
 - Could provide tracking of spacecraft w/o aid of teather
 - Support of 9/01 mission is not feasible
 - Tracking is of limited interest to project
 - Downlink at 915 MHz not economical for these antennas
 - Recommend using standard DSN or commercial satcom (Universal Space Network) uplink/downlink frequencies at S-Band
 - These antennas could be used to support X-Band or Ka-band uplink/downlink for future missions

References

- R.M. Dickinson, D.L. Losh, R.D. Barber, J.K. Dempsey, "A Phase-Control Approach for a Large-Element Coherent Microwave Power Uplink System," *IEEE Trans. Antennas and Propagation*, Vol. 47, No. 3, pp. 487-495, March, 1999.
- J.K. Dempsey, W. Mullins, R.D. Barber, D.L. Losh, A.M. Bhanji, R.M. Dickinson, "A High-Power Phased Array Transmitter Facility," *Proc. 7th Nat. Conf. High-Power Microwave Technol.*, Naval Postgraduate School, Monterey, CA, Oct. 31-Nov.4, 1994.